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ABSTRACTS.

The Solution of Silica under Atmospheric Conditions. By C. WILLARD HAYES.

While it is well known that under conditions prevailing at considerable distances below the earth's surface silica is one of the more easily soluble substances entering into the composition of the earth's crust, it is commonly regarded as the mineral least liable to be affected by solvents under ordinary atmospheric conditions. Some recent observations, however, show that even quartz pebbles are not proof against chemical as well as mechanical erosion. At several widely separated points in West Virginia and Tennessee occur coarse conglomerates, in two cases Carboniferous and a third Cambrian in age, in which the projecting portions of the pebbles have been deeply etched, evidently by solution. The pebbles vary in size up to an inch in diameter and are composed chiefly of vein quartz and quartzite together with a few of chert and feldspar, embedded in a coarse sandstone matrix. The projecting portions of these pebbles, particularly those composed of quartz and quartzite, are deeply pitted with rough, irregular surfaces, in many cases as much as a third of the pebble having been removed. From the form assumed by most of the pebbles, it would seem that their interior was more easily soluble than the outer portions. The latter usually forms a sharp rim within which is a depression with a slight elevation at the center. The etching is not confined to the larger pebbles, for on closely examining the surface of the matrix it is seen that in many places the projecting portions of the sand grains have been removed, leaving a more or less smooth mosaic. A comparison of these etched pebbles with the glyptoliths or facetted pebbles described by Woodworth and others shows clearly that they are not produced by the same agency as the latter, namely wind-driven sand. Everything, on the other hand, points clearly to solution.

Again, numerous geodes from the Carboniferous limestone in Tennessee, collected by Campbell and Taff, show etching similar to that described above. They vary from three inches to a foot in diameter and beneath the rugose opaque surface are colorless and translucent, resembling in texture extremely fine-grained quartzite or slightly granular vein quartz. Under the microscope this is seen to be made up of spherulitic aggregates of quartz grains with much coarse granular quartz but no cryptocrystalline or amorphous silica could be detected. Many of these geodes are deeply etched upon one or both sides, not only the opaque shell being removed but also portions of the translucent interior. From its microscopic character, the silica of which they are composed would appear to be but little more liable to solution than vein quartz or quartzite. Minute quantities of amorphous silica may, however, be present and by their solution facilitate the removal of the crystalline grains by solution or otherwise. Hence less importance is attached to the solution of these geodes than to the etching of the conglomerate pebbles.

The wide separation of the localities at which these cases of the undoubted solution of silica occur, renders it improbable that they are due to some peculiar and exceptional conditions, such as the presence of thermal, alkaline waters. It seems rather that they must be attributed to the action of widespread agencies working in these cases under more than ordinarily favorable conditions so that the effect is exceptionally striking. All the cases occur in a heavily forested region where there is a thick layer of humus and doubtless an abundant supply of the humus acids. Further, the region is one in which forest fires are frequent and considerable potassium carbonate must be supplied to surface waters by leaching of the resulting ashes. The conditions, therefore would appear to be favorable for a chemical process somewhat as follows: By the oxidation of the vegetable tissues in the process of decay, the humus acids are formed, chiefly humic and crenic. These absorb varying quantities of free nitrogen from the air forming the azo-humic acids, which, in turn, combine with free silica. The resulting acids combine with alkaline carbonates, particularly potassium carbonate, to form easily soluble salts. In most cases the etched surfaces of the pebbles described above support a more or less abundant growth of cryptogamic vegetation which might facilitate the solution in two ways: first by supplying humus acids directly from its own decay, and, second, by absorbing solutions of those acids from other sources and keeping the rock surfaces moist so that their solvent action might be practically continuous.

While it is readily granted that such agents seem inadequate to produce the effects observed, no others at all comparable with them in efficiency suggest themselves. And if the above conclusion is correct, a solvent capable of removing a third of a quartz pebble an inch in diameter, while still imbedded in its matrix, must be an extremely important factor in gradation when acting under the much more favorable conditions prevailing in the humus layer itself where the surface exposed by the quartz grains is vastly greater in proportion to their bulk and where the solvent action is not interrupted as it must be on exposed rock surfaces.

The Crystalline and Metamorphic Rocks of Northwest Georgia. By C. WILLARD HAYES and ALFRED H. BROOKS.

The region discussed in the paper extends southward 100 miles from the Tennessee line and westward twenty to eighty miles from the Atlanta meridian. It embraces about 4000 square miles, forming a belt to the east and south of the Georgia-Alabama Palæozoic area. The rocks of this region naturally fall into three groups: (1) the granites, gneisses and crystalline schists of the basal complex — probably Archean; (2) the slates and conglomerates of the Ocoee series — probably Algonkian; (3) intrusives in the other two series.

The first group includes the Acworth gneiss, Austell granitoid gneiss, Corbin granite and the Piedmont gneiss and crystalline schist. In the second or clastic group only four members are distinguished and formation names have not yet been assigned to them since this classification is not regarded as final. These four members are (*a*) basal conglomerate resting on the Corbin granite; (*b*) black slate often graphitic; (*c*) a series of interbedded slates and felspathic sandstones; (*d*) garnetiferous slate probably an altered phase of (*b*) and (*c*). The intrusives, which are found in association with members of both the other groups, but most abundantly in a belt from ten to twenty miles broad along their contact, named in the order of their intrusion, are (*a*) amphibolite schists and diorite; (*b*) gabbro and basic greenstone schist; and (*c*) Villa Rica granite and associated coarse pegmatites.

The above classification as well as the map accompanying the paper is to be regarded as only preliminary since the necessary petrographic study of the rocks has not yet been completed. The region discussed is embraced within the limits of the Dalton, Cartersville, Marietta, Tallapoosa, and Anniston folios of the United States Geological Survey which are now in course of preparation.

The Age of the White Limestone of Sussex County, New Jersey. J. E. Wolff and Alfred H. Brooks.

The principal new observations contributed to this well-known field by the authors were those indicating the presence of several longitudinal faults along the boundaries between the Cambrian limestone and sandstone and the white limestone and associated crystalline rocks; and the discovery, at a new quarry in Franklin, of a crevice in the white limestone which has been filled up by the overlying Cambrian arkose, which contains bowlders and fragments of the white limestone, and fragments of mica, feldspar and other minerals characteristic of the white limestone or associated rocks. From this and other localities, they conclude that the Cambrian sandstone contains the débris of the white limestone granite and associated rocks and explain the apparent transition between the blue (Cambrian) and white limestones as due to fault brecciation and shearing, and the apparent interbedding of the white limestone and quartzite as due to the deposition of the latter on the irregular surface of the white limestone, with local faulting in some places. They conclude that the white limestone is of pre-Cambrian age and an integral part of the gneissic formation. This paper will appear in full in the 18th Annual Report of the Director of the United States Geological Survey.

Erosion at Baselevel. By M. R. Campbell.

Some late observations by Mr. C. W. Hayes and the writer on the solubility of quartz under atmospheric conditions and the writer's own study of local baselevels in the Appalachian coal field seem to throw some light on the question of the ultimate result of undisturbed erosion, a result which has hitherto received but little attention from physiographers.

The conditions which seem to facilitate the solution of quartz are those which would probably prevail during the final stages of the process of baseleveling to a much greater extent than under ordinary conditions of erosion; consequently it seems probable that most, if not all, of the waste of the rocks which is washed in from the surrounding slopes is removed by solution and does not accumulate on the surface of the plain.

This conclusion is still further substantiated by the fact that in the local basins observed in the coal field, the surrounding slopes are sharply separated from the bottoms of the basins, showing that even in these small examples there is some action going on by which the waste is carried off in solution leaving the floor of the basin unobstructed and a nearly perfect plain.

If these conclusions are correct, the baseleveling epochs of the past may have been marked by very completely formed plains, and the slopes of the unreduced areas may have been sharply separated from, instead of blending with, the surface of the plain.

Origin of Certain Topographic Forms. By M. R. CAMPBELL.

The recognition of apparently abnormal physiographic forms in limited areas has induced the writer to undertake an investigation of their probable cause. Since the abnormal types are limited in their geographical distribution, they are doubtless caused by local variations in some of the conditions governing erosion. Climate and rock character are variable, but changes in them could not produce the forms in question. Declivity must be accountable. Declivity may be changed by crustal movements, but those which operate over a broad area change the declivity as a whole, and hence cannot produce local variation. Movements which are limited in their extent are the ones which must be looked to for local variation and the production of abnormal forms. Local uplifts may result in the production of normal faults, monoclinal folds, symmetrical folds, and dome-shaped uplifts; each of these structural forms, when produced during the final stage of an erosion cycle,—for at that time alone will they introduce new erosion conditions,—will be marked by physiographic features peculiar to itself.

The production of a scarp from a monoclinal fold is perhaps the most remarkable form, and it is due to a peculiar combination of slow, regular uplift, homogeneous rocks, and baseleveling conditions outside of the area affected by the uplift.

This principle is applied to the solution of the Blue Ridge scarp in North Carolina, and it is shown that the physical features of that region could have been produced by a monoclinal uplift in a broad peneplain. On this supposition the Blue Ridge plateau was once continuous with the Piedmont plain, but the latter remained at sea level while the former was slowly elevated 2000 feet. There were halts in this movement, during which partial peneplains were formed on the western side of Blue Ridge. The final result of such a combination of crustal movements and periods of baseleveling is that all of the peneplains on the western side of the Blue Ridge, collectively, represent approximately the same time interval as that represented on the eastern side by the Piedmont plain.

This theory also explains the present condition of the New River-Roanoke divide, and why the former stream has not been captured by the latter,—a crucial test for all theories relating to the origin of this scarp.

The same explanation is also suggested for the Black Hills of South Dakota,—a dome-shaped uplift in which the outer rim of Dakota sandstone is in the zone of maximum erosion, and consequently is kept at baselevel, while the inner belt of limestone owing to its more rapid upward movement is unreduced. This is offered merely as a suggestion to geologists in the hopes that it will be entertained as a working hypothesis and its applicability tested by persons familiar with the field.

Dikes in Appalachian Virginia. By N. H. DARTON.

An account was given of further discoveries of diabase dikes and of certain dikes of acidic eruptives among the Palæozoic rocks near Monterey in Highland county, Virginia. The diabase dikes are similar to those described by Messrs. Diller and Darton some years ago, but the acidic rocks are very great novelties for this region. The rock is porphyritic diorite containing quartz, mainly in rounded grains, with plagioclase, biotite, and hornblende phenocrysts, in a white groundmass. The dikes are of small extent and appear to be restricted to a limited territory. The area is one in which the most prominent anticline of central Appalachian Virginia reaches its culmination.

The abstracts in this and the previous issue of this JOURNAL were read before the Washington Meeting of the Geological Society of America.